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Assessing Tools for Coordinating Quality of Master Data in Inter-organizational Product Information Sharing

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Abstract. Product information sharing, i.e., inter-organizational transfer of master data relating to products, is a problematic, error-prone, labor-intensive, and costly process in many companies. This paper presents findings of a focus group interview and case studies at three wholesale trading companies that share product information with hundreds of suppliers. We identify and assess coordination mechanisms and tools used to facilitate product information sharing. Spreadsheet files, e-mail messages, telephone calls, and personal meetings are predominant coordination tools. EDI connections, product identification and classification standards, online product catalogs, and data pools are not widely adopted in the trading organizations covered by our study. Reasons for the low adoption rate are that employees responsible for master data quality are either unaware of these resources or that they are convinced that the tools are too cost-intensive or not flexible enough.

Keywords: Product Information Sharing, Data Quality, Master Data, Coordination Mechanism, Coordination Tool

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1 Introduction

Interoperability is a major prerequisite for the digitization of value chains. Legner and Wende [1] define business interoperability as „the organisational and operational ability of an enterprise to cooperate with its business partners and to efficiently establish, conduct and develop IT-supported business relationships with the objective to create value." [1]. Legner and Wende emphasize, that "being 'interoperable' refers to being able to share information between business partners, understand and process exchanged data, [and] seamlessly integrate it into internal ICT systems." [1] Achieving and maintaining an adequate level of quality of master data is a crucial precondition for business interoperability [2–5].

Intra-organizational issues of ensuring and maintaining quality of master data have gained extensive attention in the literature [6, 7]. However, achieving an adequate level of master data quality in inter-organizational business processes – particularly in product information sharing – has had much less attention [2, 5, 8, 9].

Product information can be defined as a set of data, e.g., identification number, weight, size, etc., that represents the product [2, 5, 9]. Product information sharing denotes the inter-organizational transfer of product information, a concept labeled "product information supply chain" by Legner and Schemm [8]. The term master data refers to critical business objects of an organization [3]. It describes products, suppliers, customers, employees, and similar objects that rarely undergo changes [10].

Data quality denotes the extent to which data meet specified requirements. Data quality is "a measure of the adequacy of the data for specific requirements [...] Data quality is a multidimensional, contextual concept, as it cannot be described with a single feature, but on the basis of different data quality dimensions and measures" [7]. A key quality characteristic is "fitness for use" [2, 6]. In a study of product information sharing de Corbière [2] identified four major data quality dimensions, namely, accuracy, completeness, timeliness and security.

The objective of our study is to identify and to assess mechanisms and tools for coordinating quality of master data in inter-organizational product information sharing. We aim to answer two research questions:

- R1: What mechanisms and tools do trade companies apply to coordinate master data quality in product information sharing with suppliers?
- R32: What strengths and weaknesses of coordination mechanisms and tools do experts perceive?

This paper is organized as follows. The next section presents findings of our literature survey. Section 3 explains the research methodology. In section 4 we describe findings of three case studies: processes, mechanisms and tools for coordinating quality of product information exchanged between wholesale trading companies and their suppliers. Section 5 presents and discusses key findings of our study. Finally, we conclude by summarizing implications for practitioners and by pointing out research opportunities.

2 Prior Research

We conducted a literature survey to identify prior research into arranging for quality of master data in inter-organizational product information sharing and to describe the state of the art in this field. In contrast to a literature review, a literature survey gives an overview of the relevant literature but does not provide a detailed analysis. Due to space limitations we cannot describe the method and our findings in full detail. Therefore, we shall limit the description to some key features here. We followed the guidelines provided by Webster and Watson [11] and vom Brocke et al. [12] to identify relevant publications. As a first step, we examined IS journals and IS conference proceedings using the AIS Electronic Library, ScienceDirect, Google Scholar, and SpringerLink. We conducted electronic searches in titles and abstracts on the following search term: [("data" AND "quality") AND (("inter-organizational" OR "business-to-business" OR "supply chain") OR ("product" AND "information" AND "sharing") OR ("data exchange"))]. These searches identified a total of 175 publications. After analyzing each article's abstract, keywords, or the full article when necessary, we excluded 144 articles that were duplicates or did not appear to be concerned with or relevant to our research focus. As a third step, we performed a forward and backward search in relevant articles to identify further sources that had not been identified by the previous step. A total of 39 publications was read in full and coded. We excluded all publications that only stated the keywords mentioned in the search term without elaborating on these concepts. Out of the 39 coded articles, 12 include passages of interest. The following statements present key findings of our survey.

- Data quality is a critical success factor for efficient cross-company collaboration [5, 13–16]. This is particularly the case for product information sharing in supply chains [2, 8, 15].
- Various studies have found that manufacturers, wholesale trading companies, and retailers are concerned about the quality of product information shared between trading partners [2, 8].
- Several surveys have shown that poor quality of product data exchanged between cooperation partners may lead to substantial cost increases or loss of sales [8, 13].
- The attempt to improve product data quality is a key driving force for using electronic exchanges of product information, e.g., the Global Data Synchronization Network (GDSN) data pool [2, 9]. Nakatani et al. [13] define a data pool as a repository that supports trading partners in obtaining, maintaining, and exchanging information on trade items in a standard format through electronic means.
- Using inter-organizational information systems for synchronizing data, e.g., data pools, electronic catalogs or marketplaces, often does not lead to the promised benefits. Trading partners also need to take steps to improve data quality internally [2, 5, 13]. Several companies are still in the process of setting up appropriate coordination mechanisms for managing their internal product information supply chain [8]. Dalmolen et al. [5], for example, found that IT personnel in large(r) organizations often have little awareness of the product information sharing

process in their own organizations. Likewise, business units lack sufficient IT knowledge to initiate potential improvements.

- Several authors [5, 9, 17, 18] found that standards for product identification and classification, e.g., the Global Trade Item Number (GTIN) and the United Nations Standard Product and Services Code (UNSPSC), and data pools, e.g., the GDSN data pool, have not gained wide acceptance in many industries because they do not meet key requirements of trading companies.
- The exchange of product information between trading partners is often supported by telephone calls, fax or e-mail exchanges. These processes are problematic, error-prone, labor-intensive, and costly [2, 8, 9, 13, 19]. Legner and Schemm [8] cite various studies that report significant direct labor costs due to the manual transfer of product information and its administrative processing as well as indirect effects of poor data quality on the supply and demand chain. Falge et al. [16] suggest that trading partners should establish a process for agreeing on common standards and systems and for defining service level agreements for data quality.
- Several scholars [2, 5, 14, 16, 19] encourage further research into data quality in the inter-organizational exchange of product information. Legner and Schemm [8] suggest qualitative and quantitative studies into sharing of product information between suppliers and retailers of goods. They also ask for more extensive investigations of interdependencies and coordination mechanisms in the inter-organizational product information supply chain.
- In our literature survey we have identified only few studies [8] that have attempted to assess mechanisms and tools for coordinating quality of master data in inter-organizational product information sharing. Most of these studies focus on only one or on a limited set of coordination mechanisms and tools. To the best of our knowledge, no author has yet attempted to assess a broad range of tools for coordinating quality of master data in inter-organizational product information sharing.
- Most of the papers included in our survey do not explicitly build on a theory. In the rare cases, when a theory for analyzing master data quality management in inter-organizational product information sharing is used [8, 14], the authors build on coordination theory.

3 Research Methodology

Our research combines a focus group interview and case study-based research. A focus group interview is an advanced form of an expert interview. Researchers interview a group of experts and document the findings for later evaluation [20–22]. Focus group interviews are well suited for acquiring new insights and ideas, and for structuring research questions into manageable chunks. In section 2 we have shown that arranging for adequate quality of master data in inter-organizational product information sharing is a research domain that has gained only little attention from scholars. Focus group interviews are especially suited for obtaining several

perspectives about a complex topic. They help to structure the research domain and to identify research questions for further investigation.

In March 2016 we conducted a focus group interview with 14 master data experts from 12 enterprises. Five are trading companies, four manufacturers, and three IT service providers. All companies are dependent on high quality master data provided by hundreds of business partners. Each company has established a team or a project with the objective to improve inter-organizational product information sharing. The focus group deals with the exchange of product master data between manufacturers and retailers. The interview helped us to identify practically relevant research fields. The interview revealed that the process of setting up products in trading companies' product databases frequently leads to severe problems due to inadequate quality of master data provided by suppliers. Therefore, ensuring an appropriate level of quality of master data is of key importance for maintaining efficient supply chains among suppliers and wholesale trading companies. This finding is consistent with the research results described in section 2 of this paper. For this reason, we focused on this field in the subsequent case study research.

Case study research examines complex and ill-structured phenomena in a practical environment [23, 24]. Our research follows a single case study approach in order to extend our knowledge of the inter-organizational exchange of product master data. This approach was chosen due to little empirical research in the domain of inter-organizational master data quality as mentioned in section 2. The case study research was structured as follows: Similar to the research approach by Legner and Schemm [8], the selection of case study organizations was mainly driven by purposeful sampling, availability of multiple sources of information, and the willingness of experts to cooperate. We decided to focus on wholesale companies as these entities act as intermediaries between suppliers and retailers of goods. Thus, wholesale companies are particularly dependent on the quality of master data relating to trade items.

We conducted semi-structured expert interviews and analyzed documents and IT artifacts provided by three case study organizations. Interview guidelines were created based on the results of a pretest with several business experts. The guidelines comprise 22 questions. The interview questions were sent by e-mail to the experts one week before interviews took place. The interviews were held between June and August 2016. We talked to a total of 10 experts in three retail companies: master data experts, procurement staff and IT personnel. The interviews lasted between 4 and 6.5 hours. All interviews were recorded. Immediately after completing the interviews, the experts' answers were documented and coded. We then analyzed all findings following the recommendations of Mayring and Fenzl [25]. Subsequently, the interview documents were provided to the experts asking them to verify the findings and to resolve potential misunderstandings. The experts also provided us with internal documents, master data descriptions and spreadsheet files used to transfer product information among trading partners. These artifacts helped us to better understand specific details, processes, mechanisms, and tools for the inter-organizational coordination of master data quality in product information sharing.

4 Processes, Mechanisms and Tools for Coordinating Master Data Quality in Product Information Sharing

In the next paragraphs we describe processes, mechanisms and tools for coordinating quality of product information exchanged between wholesale trading organizations and their suppliers.

4.1 Case 1: Wholesale Trading Company in the Retail Market

The first study was carried out in a wholesale trading company in the retail market, hereafter referred to as C1. This company employs more than 5000 people and generates an annual turnover exceeding one billion Euros. C1 procures goods from more than 2000 suppliers and sells products to about 2000 customers worldwide, mostly retail stores. C1's product database consists of more than 300,000 items. Product master data sets include 109 attributes. About 120,000 master data sets are modified per year.

The organizational unit responsible for managing product master data, labeled MDM for short, is part of C1's fulfillment department. MDM consists of 18 staff members who are in charge of master data administration related to fulfillment tasks. At C1, fulfillment is defined as order handling process spanning from responding to sales inquiries over procurement to delivery of products to the retail sector.

The process of coordinating and agreeing on an appropriate level of master data quality with suppliers consists of several steps: (1) MDM creates an Excel file that serves as a container for product master data that C1 requests from suppliers. The file specifies about 100 attributes for each product. (2) C1's procurement department sends the file to suppliers by e-mail requesting to complete 20 to 30 attributes for each product. The exact number of required attributes depends on the product category. (3) 45 percent of all suppliers fill in the relevant data and return the completed file via e-mail. Approx. 55 percent of the suppliers do not fill in the Excel file. They provide the data in other formats, e.g., CSV or XML files, or on paper. Suppliers that do not provide data in Excel files cause substantial overhead for data import and/or data entry at C1. A limited set of suppliers run a customer portal. They provide master data for wholesale customers via the portal. In these cases, C1's MDM staff import data from the portal into the Excel file. (4) When master data provided by a supplier is received, C1's procurement department checks the data entries. About half of all files provided by suppliers are appropriate and correct. The other half is incomplete or defective. Inappropriate files lead to further inquiries via telephone or e-mail when C1's employees attempt to adjust and to complete product data. (5) Frequently, the Excel file needs to be returned to suppliers requesting to rectify master data sets. (6) In the next step, procurement staff members complement the data sets with about 30 further attributes. Characteristic examples are attributes that identify or categorize products, i.e., product identification numbers. (7) The Excel file is then forwarded to MDM. This unit carries out more quality checks. (8) In case of incomplete or false data entries MDM consults the procurement department or the supplier. During this

step, the Excel file often has to be returned to the sender again with the request to complete or to amend master data sets. (9) When MDM employees consider the file appropriate they add another set of approx. 10 attributes, e.g., country-specific information needed for exporting products to international markets. (10) MDM than creates an upload file and loads the data into the database of the ERP system.

Figure 1 illustrates the process of inter-organizational product information sharing in UML notation as an activity chart.

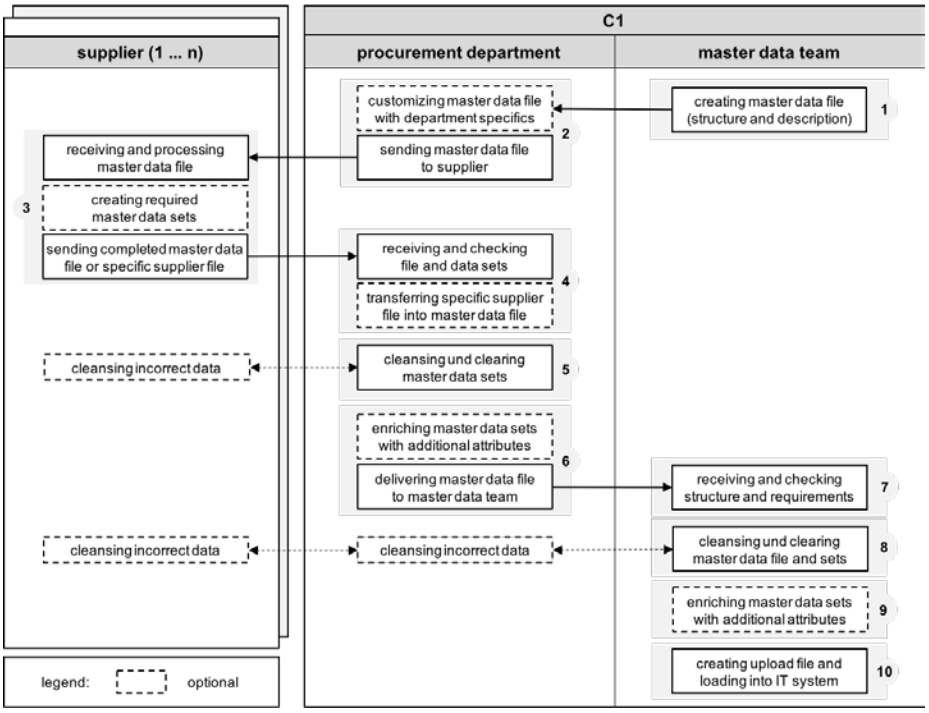

Figure 1: Overview of the process of product information sharing

4.2 Case 2: Wholesale Trading Company in the Automotive Aftermarket

The second case study was conducted in a wholesale trading company in the automotive aftermarket, hereafter called C2. The company has more than 5000 employees and generates approx. 1.6 billion Euros turnover per year. C2 purchases parts from more than 2000 suppliers and sells products to approx. 30,000 customers, mostly garages in five European countries. The stock of articles comprises 1.5 million items. Product master data sets consist of 92 attributes. 50,000 to 120,000 master data sets need to be modified per day.

The organizational unit responsible for managing master data is part of the procurement department and employs 8 people. They are in charge of master data administration related to all procurement tasks. However, master data team members

usually do not directly communicate with suppliers. This is one of the duties of procurement staff.

Basically, C2's process of coordinating master data quality is similar to C1's process. In order to avoid repetitions, we refrain from describing the entire process again. We only mention specific features of C2's process in this section.

- C2's framework contracts with suppliers comprise a clause that mutually obligates trading partners to supply master data in adequate quality. However, this clause does not specify any details.
- C2's Excel file sent to suppliers consists of 92 attributes. 20 attributes are mandatory fields that must be filled in by suppliers.
- C2 utilizes the TecDoc catalog [26], a standardized electronic parts catalog that contains data sets for more than 5,400,000 products in the automotive aftermarket. Missing, incomplete or inaccurate data sets are complemented by C2's staff with data obtained from this catalog.
- Unlike C1, C2 utilizes several automatic routines to check quality of master data provided by suppliers before uploading master data sets into the product data base.
- Similar to the process at C1, C2's procurement staff members communicate with suppliers, request product master data and provide suppliers with Excel files to fill in the master data. Procurement employees frequently modify spreadsheet files sent to suppliers in order to better adapt to the specific requirements. This leads to an ambivalent situation: On the one hand the Excel files are tailored to the specific requirements of procurement units and to certain product categories. On the other hand, procurement staff members do not communicate these modifications to personnel in the master data unit. This leads to inconsistencies in master data sets, to frequent check backs, and to substantial rework.

4.3 Case 3: Purchasing Association in the Furniture Industry

Case 3 describes coordinating quality of product master data in a purchasing association in the furniture industry, hereafter referred to as C3. The association serves as a mediator between furniture manufacturers and retailers. C3 draws up and makes framework contracts between producers and vendors, and provides procurement, marketing, financing, and IT services. C3 supports, for example, the exchange of master data between furniture suppliers and retailers. C3 employs more than 50 people and generates an annual turnover of about 50 million Euros. 700 furniture producers and dealers are members of C3.

C3's product data base contains about 100,000 master data sets. More than 1000 new master data files are imported and approx. 30,000 master data sets need to be modified per year. The organizational unit responsible for managing master data directly reports to C3's executive board. The master data team consists of 5 employees. C3's process of arranging for and agreeing on an appropriate level of master data quality is similar to the processes at C1 and C2.

- C3 sends Excel files to furniture manufacturers requesting to provide master data in a form that meets requirements of furniture retailers. About 50 percent of the suppliers fill in the templates and provide master data in Excel files. The other half provides master data sets in proprietary formats, in PDF files, or on paper.
- Similar to the situation at C1 and C2, a high percentage of all files provided by suppliers are incomplete or incorrect. This gives rise to frequent check backs. The process is labor intensive and causes high personnel cost. However, our interview partners were not able to quantify efforts needed to complete or to amend master data sets.
- C3's procurement team regularly communicates with suppliers. They attempt to clarify any inconsistencies. However, arranging for and ensuring an appropriate level of master data quality is not a top priority for procurement personnel. Master data experts are not involved in talks and negotiations with furniture manufacturers. Similarly, C3's IT department does not actively support the process of exchanging master data with suppliers.
- Unlike C1 and C2, C3 does not complement master data sets with additional attributes. C3 serves as a data broker only.
- C3 does not apply any product identification or classification standard. They neither use EDI messages for transferring master data nor data pools for enriching and amending incomplete or incorrect data sets.
- C3 does not use any automatic routines to check the quality of master data provided by suppliers before transferring master data sets to furniture retailers. Once C3's master data team considers the data sets appropriate, they transfer the data into a product data base. Product information is then made available for furniture retailers via C3's extranet, a controlled private network allowing members to gain proprietary information.

5 Findings and Discussion

In this section, we answer the research questions and discuss findings of our study. We first present the assessment of coordination tools used by the trading companies included in our case studies. We then analyze our findings using the lens of coordination theory.

5.1 Assessment of Coordination Tools used by Trading Companies

During the case study interviews, we identified a set of eight coordination tools that are applied to define and to check quality of product master data exchanged between suppliers and wholesale companies. However, as already mentioned in section 4, not each company included in our study makes use of all of these tools.

As part of the case study interviews, we asked participants to assess the tools. We invited the experts to qualitatively evaluate strengths and weaknesses of the tools. Table 1 shows the results of the assessment.

Table 1. Assessment of coordination tools for ensuring quality of product master data

Coordination Tools	*Strengths*	*Weaknesses*
Framework contract	- provides legal basis for data exchange including confidentiality agreements	- does not specify requirements for master data quality
MS Excel file	- ease of use - high adoption rate - simple editing - no IT expertise required - low set up cost	- most suppliers do not document modifications in files - complex rework required - automated validation of master data sets not feasible - files are not self-descriptive
EDI message	- standardized, tested and reliable technology - reliable data sets	- low adoption rate - EDI messages cannot easily be tailored to specific requirements - high implementation cost
Customer portal	- automatic syntax check - documentation of all operations in log files	- specific "look and feel" of each portal - insufficient ease of use - data sets are not tailored to specific needs of trading partners
Online product catalog	- all products can be mapped and made available	- trading partners must be persuaded to use product catalogs
Identification and Classification standard	- high data quality - high adoption rate - full documentation and good support	- cannot be tailored to specific requirements - low adoption rate
Data pool	- covers a wide range of products - focus on specific industries - high data quality - unified communication platform - communication processes are logged	- limited number of attributes - specific "look and feel" of each data pool - high access and usage fees - not all business partners have access
Mutual adjustment (e-mail messages, telephone calls, personal meetings)	- ease of use - flexibility	- error prone - labor-intensive - costly

5.2 Analyzing the Cases Using the Lens of Coordination Theory

We build on coordination theory to structure our findings and to reflect the insights we gained in our case studies. Malone and Crowston [27] define coordination as “the act of managing dependencies between entities and the joint effort of entities working together towards mutually defined goals”. Coordination theory is the “body of principles about how activities can be coordinated, that is, about how actors can work together harmoniously” [28]. Thus, coordination theory focuses on essential questions of inter-organizational product information sharing, namely, how trading partners can work together harmoniously in order to ensure smooth and cost-efficient supply processes and how they can manage interdependencies resulting from the need to operate on high quality product master data. Another reason for selecting coordination theory as a theoretical basis is that it matches well with our research questions. Coordination theory explores which types of coordination mechanisms have which

strengths and shortcomings under which conditions [27, 29, 30]. Moreover, it has been successfully applied by prior research into inter-organizational product information sharing [8, 14].

Inter-organizational coordination of master data quality is a highly complex, yet hardly systematized or automated process in the companies covered by our study. The process of check backs and providing previously missing or defective data is not standardized or automated. Procurement employees and master data staff perform these tasks on an ad hoc basis. Most subtasks are performed manually. Apparently, many suppliers and their customers make considerable efforts to achieve and to maintain an adequate level of master data quality. However, options for standardization, rationalization, and automation have not yet been fully used by the companies included in our study. These findings confirm the research results of Legner and Schemm and Otto et al. [4, 8].

Several authors [27–31] have suggested frameworks that describe basic concepts of inter-organizational coordination.

Actors denote individuals and organizational units responsible for coordination [28]. Entities responsible for the quality of product master data are centralized in all companies covered by our study. However, the process of coordinating master data quality with suppliers is decentralized. Procurement personnel and staff members of master data teams are involved. Both entities adjust incorrect data and complement incomplete data sets. This requires additional intra-organizational coordination effort. We had expected that IT departments play a crucial role in the exchange of master data sets and in ensuring and improving master data quality. However, IT departments do not actively participate in this process. IT staff run the IT infrastructure and they assist in uploading master data files into ERP systems. Yet, they are not consulted when it comes to technical solutions for improving inter-organizational coordination of master data quality.

Interdependencies are “goal-relevant relationships between the activities” [28].. According to Malone and Crowston [28] interdependencies can be analyzed in terms of common objects. Common objects in a trading relationship are trade items and product master data sets that are transferred between trading partners. However, master data are not of key importance for all actors participating in the trading process. Procurement personnel rather focus on trade items, prices, and terms and conditions. Improving quality of master data is seen as an annoying and bothersome technical task. Thus improving quality of master data does not receive the necessary attention. As mentioned before, IT personnel – who would be able to adequately assess the importance of the task – usually are not involved in inter-organizational product information sharing.

Romano [32] differentiates between several types or configurations of inter-organizational relationships. A dyadic network involves the interaction between two firms (1:1), a multiple dyadic network involves the interaction of one firm with several other firms (1:n or n:1). A many-to-many network is one where several firms interact with several other firms (m:n). The types or configurations analyzed in our study are multiple dyadic networks. This corresponds to the results of Le Dû and de Corbière [19] who found that synchronization of product information is mainly

performed on a dyadic basis. Each of the three wholesale organizations has trade relations to several hundred suppliers. Quality of master data needs to be arranged, agreed on, and checked on a one-to-one level between trading partners. Obviously, the extent and complexity of this task makes it impossible to ensure an adequate quality of product information exchanged with all trading partners.

Xu and Beamon [29] define coordination mechanisms as a set of methods used to manage interdependencies between organizations. Coordination tools are specific elements of organizational action, interaction or behavior that enable inter-organizational coordination [31]. Arshinder et al. [30] suggest identifying whether a single or a combination of mechanisms are required to tackle complexities in supply chain coordination. The wholesale trading companies included in our study apply a multifaceted set of methods to coordinate master data quality with suppliers. However, Excel files are the predominant coordination tools. These files allow trading companies to accurately define quality specifications for product master data. By defining attributes and macros in spreadsheet files, wholesale trading companies attempt to standardize product master data sets requested from their suppliers. However, a considerable number of files provided by suppliers are incomplete or incorrect. This gives rise to frequent check backs. Furthermore, it is worth stressing, that our analysis of these tools revealed several weaknesses. Some of the Excel files used in the companies covered by our study are difficult to use, partly incorrect or technically outdated. This makes it more difficult for suppliers to provide master data in an appropriate quality.

Numerous incomplete and defective data sets provided by suppliers require frequent check backs. E-mail messages and telephone calls are regularly used to support mutual adjustment by data experts at trading companies and their suppliers.

In some cases, suppliers provide master data sets in EDI messages. Only a very limited set of suppliers provide master data for wholesale customers via customer portals or online product catalogs. Product identification and classification standards are used to a very limited degree in the companies covered by our study. Only one company utilizes a data pool. On the one hand, a more intensive use of standards and tools provided by electronic intermediaries, e.g., data pools and electronic catalogs, may contribute to improving product data quality in inter-organizational product information sharing and to reducing the workload for most trading partners. On the other hand, these tools obviously need to be complemented by bilateral arrangements that account for specific requirements of the particular trading partners.

Our findings confirm the results of previous research [1, 4, 5, 8, 9, 14, 18, 19, 33]. Earlier studies revealed that EDI connections, identification and classification standards, product catalogs, and data pools are not widely adopted in most industry sectors. Instead, most companies prefer Excel files and personal communication to coordinate master data quality in inter-organizational product information sharing.

These phenomena can be explained with experts' perceptions of strengths and weaknesses of the coordination mechanisms and tools described in section 5.1. Personnel in master data teams and procurement staff in the companies covered by our study either do not have sufficient knowledge of standards, EDI technology,

product catalogs, or data pools or they are convinced that these resources are too cost-intensive or not flexible enough.

6 Conclusion

6.1 Implications for Practitioners

The insights we gained in our study indicate some interesting options for improvement. We believe the recommendations presented in this section might also be relevant for other organizations facing similar issues.

Only one company included in our study explicitly mentions exchange of product information in framework contracts with trading partners. This could encourage other companies to do the same to raise awareness for achieving and maintaining adequate quality of master data in inter-organizational product information sharing.

The process of coordinating quality of product information with trading partners is only scarcely systematized and automated. A higher level of standardization and automation could help increase process efficiency, improve master data quality, and reduce personnel cost. This, however, would require establishing a well-defined process that is accepted by all trading partners, specifically by master data experts. Further above we have outlined the current state of the process for coordinating product master data quality. Defining and testing an improved process that is more intensively systematized, automated, and accepted by all parties would be an essential improvement. An improved process including automated mechanisms and tools could release all trading partners from manual data entries and cost-intensive rework after having received incomplete or inappropriate master data sets.

We do not expect that such a process can be established in the short term. In the meantime, however, regular meetings of master data experts of selected suppliers and customers could help to improve the exchange of master data with at least some trading partners. Best practices that hopefully result from these forms of cooperation could then be adopted by more trading partners.

6.2 Research Opportunities

Although the nature of our study is such that no universally applicable conclusions can be drawn, our findings at least illustrate the necessity to conduct more in-depth research into coordinating master data quality in inter-organizational product information sharing. There are a number of interesting extensions for future research.

One area is to include more companies in future studies. It would be particularly interesting, to interview master data experts employed at suppliers and their contact partners in trading companies in order to gain more complete insights into benefits and downsides of applying coordination mechanisms and tools in inter-organizational master data sharing. Another option to broaden research is to explore inter-organizational coordination in other sectors (e.g., manufacturing, healthcare etc.) to identify potential differences in coordinating quality of product information.

We also encourage scholars and practitioners to design, implement and evaluate software tools that support coordinating quality of product master data in inter-organizational relations. Such tools could help to define requirements for master data to be exchanged among trading partners. Software tools could support examining the extent to which requirements are fulfilled. Some authors [17, 34–36] have proposed platforms and services for improving quality of shared data in cooperative information systems. The functionality of these tools seems to be limited and none of the tools has been developed to a product that is available on the market. However, the papers may provide an interesting starting point for the design and development of more comprehensive tools. Automated coordination tools could provide workflows for adjusting incorrect data or complementing incomplete data sets between trading partners. Once, such a tool is completed it would be highly interesting to explore whether it can help to reduce costs of coordinating quality of master data and, if so, to what extent.

References

1. Legner, C., Wende, K.: The Challenges of Inter-Organizational Business Process Design - A Research Agenda. In: ECIS 2007 Proceedings (2007)
2. de Corbière, F.: Interorganizational Information Systems and Data Quality Improvement: The Case of Product Information in the French Large Retail Industry. In: ICIQ 2007 Proceedings (2007)
3. Loshin, D.: Master Data Management. Morgan Kaufmann, Amsterdam (2008)
4. Otto, B., Abraham, R., Schlosser, S.: Toward a Taxonomy of the Data Resource in the Networked Industry. In: ISSL 2014 Proceedings (2014)
5. Dalmolen, S., Moonen, H., van Hillegersberg, J.: Industry-wide Inter-organizational Systems and Data Quality: Exploratory findings of the use of GS1 standards in the Dutch retail market. In: AMCIS 2015 Proceedings (2015)
6. Wang, R.Y., Strong, D.M.: Beyond Accuracy: What Data Quality Means to Data Consumers. Journal of Management Information Systems 12, 5–33 (1996)
7. Otto, B., Österle, H.: Corporate Data Quality. Springer, Heidelberg (2016)
8. Legner, C., Schemm, J.: Toward the Inter-organizational Product Information Supply Chain - Evidence from the Retail and Consumer Goods Industries. Journal of the Association for Information Systems 9, 119–150 (2008)
9. Madlberger, M.: Can data quality help overcome the penguin effect? The case of item master data pools. In: ECIS 2011 Proceedings (2011)
10. Haug, A., Stentoft Arlbjørn, J.: Barriers to master data quality. Journal of Enterprise Information Management 24, 288–303 (2011)
11. Webster, J., Watson, R.T.: Analyzing the Past to Prepare for the Future: Writing a Literature Review. MIS Quarterly 26, xiii–xxiii (2002)
12. vom Brocke, J., Simons, A., Niehaves, B., Riemer, K., Plattfaut, R., Cleven, A.: Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process. In: ECIS 2009 Proceedings (2009)
13. Nakatani, K., Chuang, T.-T., Zhou, D.: Data Synchronization Technology. Communications of the Association for Information Systems 17, 962-996 (2006)
14. de Corbière, F.: Data Quality and Interorganizational Information Systems: The Role of Electronic Catalogues. In: AMCIS 2009 Proceedings (2009)

15. Hüner, K.M., Schierning, A., Otto, B., Österle, H.: Product data quality in supply chains. The case of Beiersdorf. Electronic Markets 21, 141–154 (2011)
16. Falge, C., Otto, B., Österle, H.: Data Quality Requirements of Collaborative Business Processes. In: HICSS 2012 Proceedings (2012)
17. Cai, Y., Shankaranarayanan, G.: A Data Quality Assurance Model in the B2B Networked Environment. In: AMCIS 2004 Proceedings (2004)
18. de Corbière, F., Rowe, F.: Understanding the Diversity of Interconnections between IS: Towards a New Typology of IOS. In: ECIS 2010 Proceedings (2010)
19. Le Dû, A.-C., de Corbière, F.: IQ as an enabler of the green and collaborative supply chain. In: ICIQ 2011 Proceedings (2011)
20. Morgan, D.L.: Successful Focus Groups: Advancing the State of the Art. SAGE, Thousand Oaks (1993)
21. Rosemann, M., Vessey, I.: Toward Improving the Relevance of Information Systems Research to Practice: The Role of Applicability Checks. MIS Quarterly 32, 1–22 (2008)
22. Chiarini Tremblay, M., Hevner, A.R., Berndt, D.J.: The Use of Focus Groups in Design Science Research. In: Hevner, A., Chatterjee, S. (eds.) Design Research in Information Systems. Theory and Practice, pp. 121–143. Springer, Boston (2010)
23. Eisenhardt, K.M., Graebner, M.E.: Theory Building from Cases: Opportunities and Challenges. Academy of Management Journal 50, 25–32 (2007)
24. Yin, R.K.: Case study research. Design and methods. SAGE, Los Angeles (2014)
25. Mayring, P., Fenzl, T.: Qualitative Inhaltsanalyse. In: Baur, N., Blasius, J. (eds.) Handbuch Methoden der empirischen Sozialforschung, pp. 543–556. Springer, Wiesbaden (2014)
26. TecAlliance GmbH: TecDoc catalog, https://www.tecalliance.net/en/products/tecdoc-catalogue-portal/ (Accessed: 20.06.2106)
27. Malone, T.W., Crowston, K.: The Interdisciplinary Study of Coordination. ACM Computing Surveys (CSUR) 26, 87–119 (1994)
28. Malone, T.W., Crowston, K.: What is coordination theory and how can it help design cooperative work systems? In: CSCW 1990 Proceedings (1990)
29. Xu, L., Beamon, B.M.: Supply Chain Coordination and Cooperation Mechanisms: An Attribute-Based Approach. Journal of Supply Chain Management 42, 4–12 (2006)
30. Arshinder, K., Kanda, A., Deshmukh, S.G.: A Review on Supply Chain Coordination: Coordination Mechanisms, Managing Uncertainty and Research Directions. In: Choi, T.-M., Cheng, T.E. (eds.) Supply Chain Coordination under Uncertainty, pp. 39–82. Springer, Heidelberg (2011)
31. Alexander, E.R.: Interorganizational Coordination: Theory and Practice. Journal of Planning Literature 7, 328–343 (1993)
32. Romano, P.: Co-ordination and integration mechanisms to manage logistics processes across supply networks. Journal of Purchasing and Supply Management 9, 119–134 (2003)
33. Ofner, M.H., Otto, B., Österle, H.: Integrating a data quality perspective into business process management. Business Process Management Journal 18, 1036–1067 (2012)
34. Mecella, M., Scannapieco, M., Virgillito, A., Baldoni, R., Catarci, T., Batini, C.: Managing Data Quality in Cooperative Information Systems. In: CoopIS 2002 Proceedings (2002)
35. Scannapieco, M., Virgillito, A., Marchetti, C., Mecella, M., Baldoni, R.: The DaQuinCIS architecture. Information Systems 29, 551–582 (2004)
36. Becker, J., Matzner, M., Müller, O., Winkelmann, A.: Towards a Semantic Data Quality Management - Using Ontologies to Assess Master Data Quality in Retailing. In: AMCIS 2008 Proceedings (2008)